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Moab Project

Groundwater and Tailings Pile Characterization Activities to Support the Plan for Remediation

Work Plan

June 2002

Prepared for
U.S. Department of Energy
Grand Junction Office

Work Performed Under DOE Contract Number DE–AC13–96GJ87335
Task Order Number MAC02–16

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Acronyms

BLM	U.S. Bureau of Land Management
DOE	U.S. Department of Energy
EA	environmental assessment
EIS	environmental impact statement
ECL	environmental checklist
ft	feet
PFR	Plan for Remediation
RRM	residual radioactive material
SHPO	Utah State Historic Preservation Office
SOW	statement of work
TDS	total dissolved solids
WRR	work readiness review

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1.0 Introduction

The U.S. Department of Energy (DOE) is currently in the process of preparing a revision to the draft Plan for Remediation (PFR) of the tailings and groundwater contamination at the Moab site. The subsurface hydrogeology and geochemistry warrant more study in the vicinity of the Moab site and tailings area in order to bound uncertainties in refining the conceptual site model. The draft PFR identified additional characterization needs (“data gaps”) required to reduce uncertainties in the targeted remediation alternatives. A sensitivity analysis (DOE 2002) of the groundwater flow and transport model used to develop the groundwater remediation strategy suggests that more information regarding the “water budget” is required to support the site conceptual model before comparative differences in the effectiveness and time frames for the cleanup alternatives can be evaluated. In addition, more information is required to better understand potential contamination in the subpile sediments so that more refined cost estimates for surface remediation can be developed and to evaluate the impacts of a potential continuing source of groundwater contamination.

DOE is planning additional site characterization to collect information to reduce uncertainties in the PFR. A description of the data collection objectives for characterizing the water budget and a potential continuing source beneath the pile is described below. Proposed monitor wells and sample locations are shown on Figures 1 and 2.

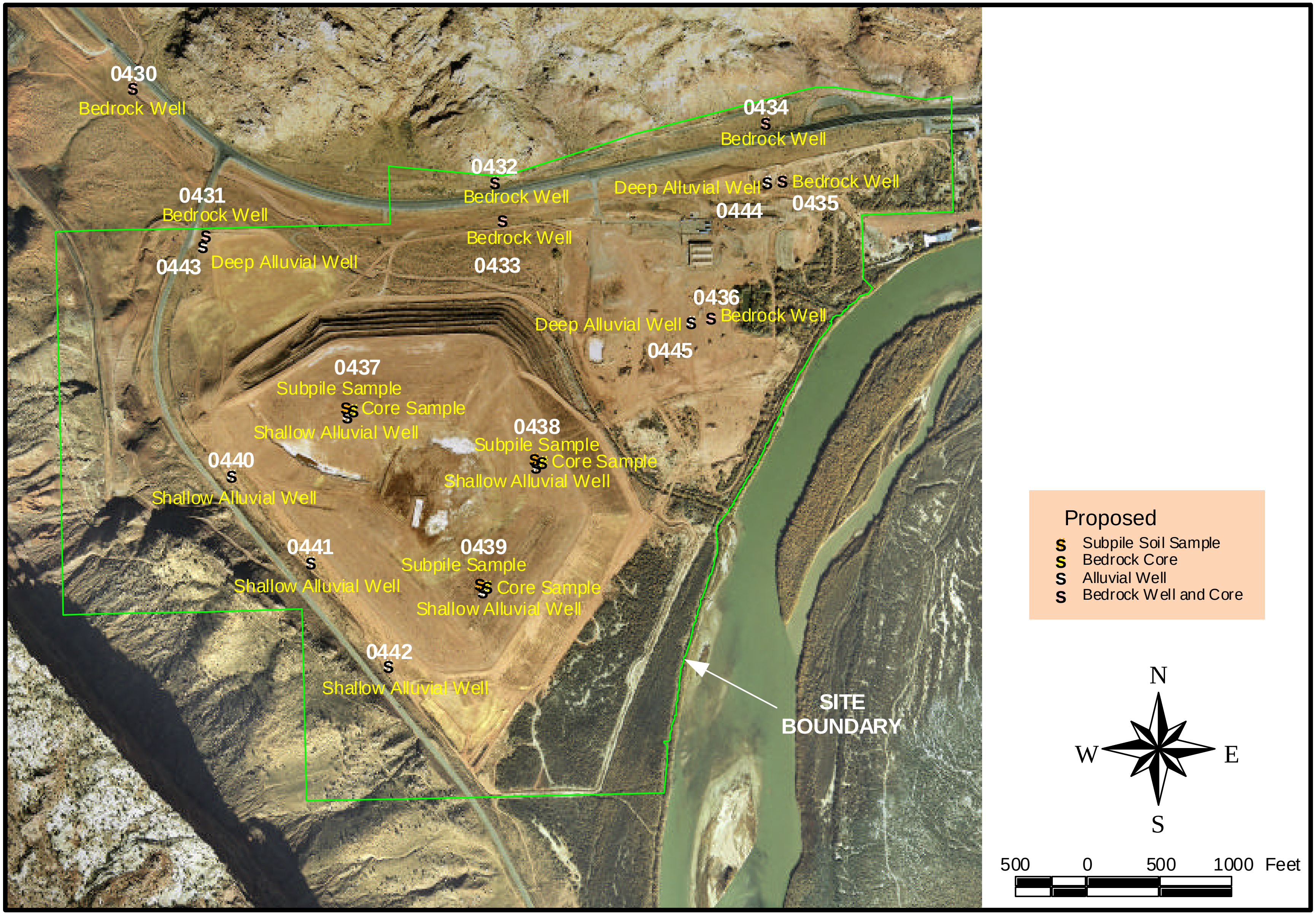

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Figure 1. Proposed Sample and Well Locations

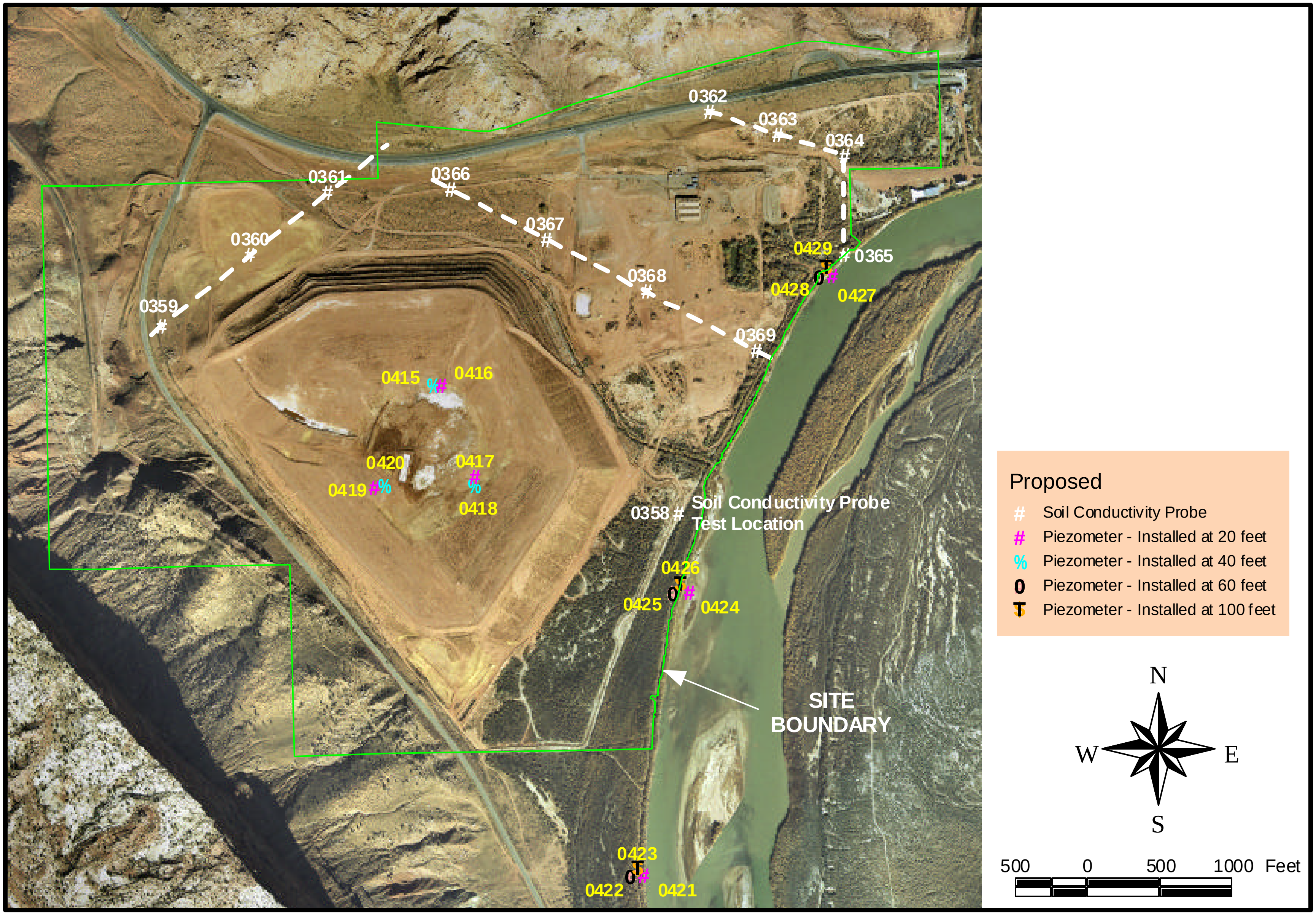

Figure 2. Proposed Piezometer Installations and Soil Conductivity Measurement Location

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2.0 Water Budget Characterization

2.1 Background

The most current conceptual model for the site assumes a significant amount of the total groundwater recharge to the alluvial system originates as upward flow from the Glen Canyon bedrock formation (SMI 2001). However, examination of the very limited amount of site characterization data that is currently available suggests otherwise. For example, two bedrock borings (TH–27 and AMM–1) located at the northwest and northeast corners of the site boundary, respectively, encountered Moenkopi Formation which is an effective aquitard. In another example, apparent downward hydraulic gradients are observed at the SMI–PW–03 location where nested alluvial wells are established near the center of the site where most of the upward flow from the Glen Canyon is postulated.

Specific conductance measurements from water samples collected from the bottom of a deep alluvial well installed near the center of the site (SMI–PW–03) suggests the presence of an interface between fresh water and an underlying brine unit. The presence of a brine unit would preclude upward flow of fresh water from the bedrock formation. DOE wants to determine where the fresh water at the site originates from and estimate the flux.

Another reason for characterizing the fresh water and brine interface is because it may be possible that manipulating groundwater gradients by either a passive remediation (i.e. phyreatophytes) or by an active pumping well field may induce upward flow of brine from the lower hydrostratigraphic unit, thus potentially adversely affecting the upper fresh water zone. Furthermore, the presence of even moderate amounts of brine in the upper fresh water zone could classify the groundwater as limited use and would qualify the groundwater for supplemental standards based on concentrations of total dissolved solids (TDS) in excess of 10,000 milligrams per liter [40 CFR 192.11(e)(1)].

Limited characterization data also exists for other boundaries at the site where lateral recharge to the alluvial groundwater may be occurring such as along Moab Wash and the contacts between the alluvium and bedrock in subcrop.

2.2 Scope of Work

The primary data sets to characterize the water budget consists of obtaining the following information:

- Core samples to identify the geologic bedrock formation sub cropping at the site (430-439).
- Monitor wells completed in the alluvium and bedrock formation to evaluated vertical flow gradients at the site (431 and 433, 436 and 445, 435 and 444), to better estimate lateral recharge to the alluvium near the northern (432 and 433, 434 and 435) and western (440-442) boundaries of the site, and to define the elevation and saturated thickness of the alluvial water beneath the tailings pile (437, 438, and 439).
- Piezometers installed at various depths along the river to evaluate vertical flow gradients and to determine the hydrologic interactions between the river and the alluvial aquifer (421-429).

- Electrical soil conductivity logs collected by direct-push methods to map the vertical and horizontal extent of the brine zone (358-369).

A casing-advanced drilling method (Sonic) will be used to obtain the core samples and to drill the boreholes for the monitor well installations. The drilling statement of work (SOW) provided in Appendix A presents the details. The Sonic method used to drill through the tailings pile consists of setting a casing at the base of the tailings and then applying a bentonite seal at the contact or filling the inner casing with grout before advancing the borehole below the tailings layer. This method will ensure that downward leakage of tailings pore fluids and materials are prevented during and after the drilling operation.

A direct-push method will be used to collect electrical soil conductivity measurements. Auger drilling will be used to install the piezometers in the alluvial sediments along the river. The SOW for the piezometer installations and soil conductivity measurements is provided in Appendix B.

Standard operating procedures for collecting samples and performing field tests for these activities are listed in Appendix C.

3.0 Source Term Characterization

3.1 Background

Groundwater beneath the tailings pile has been limited to a single sampling event at 3 locations. Analytical results for some constituents at these temporary locations suggest that minimal groundwater contamination is present in the alluvial aquifer beneath the pile and that the relative concentrations for the more mobile constituents are much lower than groundwater contamination near the river. This suggests that the vertical and horizontal extent of groundwater contamination beneath the Moab pile may not be adequately characterized. Uncertainties in the extent and nature of contamination could lead to underestimating the volume of groundwater that may require cleanup, the effectiveness of the treatment technology selected, and the time period required for natural flushing.

Approximately 30 to 40 feet (ft) of unsaturated subpile sediments may be present beneath a hardened, low permeability base underlying the tailings (borings AR–4D, –4, and –7) (SRK 2000). However, the extent of any potential subpile contamination has not been evaluated. Contamination in the subpile sediments may limit the effectiveness of either an active remediation or a natural flushing strategy, since the contamination would act as a continuing source. At other Uranium Mill Tailings Remedial Action Project Title I sites DOE's experience suggests that natural flushing is more likely to be successful in a shorter period of time if the continuing source is removed. Thus, the actual groundwater cleanup time assumed for the cap-in-place option in this plan would be underestimated. Similarly, the assumed amount of subpile soils excavated (2 ft) for the off-site disposal option would be underestimated.

3.2 Scope of Work

The primary data sets to characterize a potential subpile source term consists of obtaining the following information:

- Sediment samples collected at multiple depths from the hardened base layer (silt?), the unsaturated zone, and from the upper saturated zone beneath the tailings pile (437-439). Analyze sediment samples for leachability, distribution coefficient (K_d) determinations, and/or total digestions and water samples for constituents of concern.
- Piezometers installed at different depths in saturated portions of the tailings to evaluate vertical flow gradients (415-420).

A casing-advanced drilling method (Sonic) will be used to obtain samples from and beneath the tailings and to drill the boreholes for the monitor well installations. The drilling statement of work (SOW) provided in Appendix A presents the details. The Sonic method used to drill through the tailings pile consists of setting a casing at the base of the tailings and then applying a bentonite seal at the contact or filling the inner casing with grout before advancing the borehole below the tailings layer. This method will ensure that downward leakage of tailings pore fluids and materials are prevented during and after the drilling operation.

A direct-push method will be used to install the piezometers in the tailings. The SOW for the piezometer installations is provided in Appendix B.

Standard operating procedures for collecting samples and performing field tests for these activities are listed in Appendix C.

4.0 Health and Safety

The site-specific Health and Safety Plan (DOE 2001) has been prepared for the Moab Project in accordance with the requirements of 29 CFR 1910.120. All fieldwork will be performed according to the site-specific health and safety requirements developed for this task (DOE 2001) and the MACTEC–ERS operational health and safety regulations as outlined in the *Drilling Health and Safety Requirements*, MAC–2012, Revision 3, October 2000.

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5.0 Regulatory Compliance

The following regulatory drivers were determined to be applicable to the scope of work addressed in this work plan.

National Environmental Policy Act—With the exception of one off-site well (430) located on BLM lands, the proposed activities are addressed in the Environmental Checklist (ECL) (GJP 01–02) recommending categorical exclusion, which was approved by the DOE on November 8, 2001. Location 430, north of the site, (T25S, R21E, Section 28, NW4 NE4) is being assessed for impacts under a U.S. Bureau of Land Management (BLM) Environmental Assessment (EA). DOE will then consider adopting the BLM EA as sufficient for meeting DOE National Environmental Policy Act regulations. Work will not commence at location 430 until DOE has determined the adequacy and the BLM NEPA documentation.

National Historic Preservation Act—There is no evidence, including the EIS, that investigations and surveys were ever conducted within the site boundaries. At the time the site was disturbed (1950s) the land was in private ownership and not subject to the National Historic Preservation Act, which was enacted at a later date. The majority of the site surface is sufficiently disturbed, so further investigation at this time appears unnecessary. In addition, a letter dated September 19, 1994 from the Utah Division of State History (Appendix H, EIS), which concurs with proposed on-site disturbances and reclamation. However, a literature search will be conducted for the entire site to determine if any areas within the site boundary have ever been surveyed or investigated. Results will be confirmed by the archeological subcontractor with the Utah State Historic Preservation Office (SHPO).

For activities outside the site boundary (e.g. well location 430) an archeologist licensed in the State of Utah was subcontracted to investigate the need for further archeological clearances. Results will be reported to the appropriate land management agency (e.g. BLM) and clearances received from the SHPO. Mitigation, including avoidance if necessary, will be complied with.

Threatened/Endangered Species—DOE has conducted informal consultation routinely with the U.S. Fish and Wildlife Service and was authorized to proceed with work in areas that would not adversely affect potentially suitable southwest willow flycatcher habitat. The proposed activities will not adversely affect Threatened and Endangered species or their habitat.

State of Utah Well Installation Regulations—Permanent piezometers installed in the tailings pile and electrical conductivity probing using a direct-push method will not require notice or permitting with the State of Utah. Any temporary or permanent well less than 30 ft will not require notice or permitting with the State of Utah. Monitor wells installed greater than 30-ft in depth will require notice and permitting with the State of Utah. Environmental Services has applied for the permits.

Waste Management—Drill cuttings and well development water within the site boundary can be disbursed around the drill locations. It is assumed that soils within the site boundary are contaminated and will be remediated at a later date. Soils outside the site boundary could be contaminated; therefore, cuttings and development waters in suspect areas will be managed in accordance with the Management Plan for Field-Generated Investigation Derived Waste (DOE 2000). If, for any reason, locations outside the millsite boundary are suspected of being contaminated and special circumstances exist that the management plan does not address the project manager will contact Environmental Services to determine site-specific management requirements. If cuttings, development waters, or other waste requires management (i.e. drumming, transportation, storage, disposal), including relocation of drummed residual radioactive material (RRM) to the millsite, Environmental Services will be contacted to coordinate storage and disposal with the project manager.

Land Ownership and Relations—Some of the proposed activities are located on private land to the south of the site. Access will be obtained and the landowner notified of potential environmental concerns, including archeological and threatened or endangered species.

6.0 Logistics and Schedule

A work readiness review (WRR) will be conducted by MACTEC–ERS at the Grand Junction Office before the team mobilizes for field sampling and mapping activities. The purpose of the WRR is to ensure that all personnel, facilities, systems, and processes are ready before the start of the fieldwork and to minimize the possibility of delays and problems due to incomplete planning and preparations.

Examples of specific topics that will be addressed include health and safety, training requirements, personnel resources, site access, equipment and supplies, and work tasks. A checklist specific to the field task will define the WRR scope.

A general schedule for each activity is summarized below.

Date	Activity
June 17–29, 2002	Direct-push piezometer installations and electrical conductivity measurements.
July 8 through August 16, 2002	Bedrock coring, monitor well installations, subpile soil sampling.
August 5 through September 20, 2002	Develop and sample new monitor wells. Physical survey of well locations and elevations. Laboratory analysis of subpile soil and groundwater samples.
August 9 through November 8, 2002	Input to PFR (analyze data, prepare maps, calculation sets, update site conceptual model, revise and edit text).

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7.0 Deliverables

The primary deliverable is input to the revised PFR. To support the revision several preliminary data/calculation sets will be developed, such as (1) well completion logs, (2) piezometer installations, (3) electrical conductivity measurements, (4) packer tests, (5) subpile soil analysis, and (6) an updated site conceptual model. After the revised PFR is submitted on November 8, 2002 a characterization report will be prepared that synthesizes all the field activities to support the development of a final compliance strategy.

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8.0 References

Shepard Miller, Inc. (SMI), 2001. *Site Hydrogeologic and Geochemical Characterization and Alternatives Assessment for the Moab Mill Tailings Site, Moab, Utah*, April.

SRK, 2000. *Dewatering Options for Placement of Cover—Moab Tailings Impoundment*, prepared for the Moab Mill Reclamation Trust c/o PricewaterhouseCoopers LLP, Houston, Texas, June.

U.S. Department of Energy (DOE), 2001. *Moab Health and Safety Plan*, GJO–MOA1.3, prepared for the U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado.

———, 2000. *Drilling Health and Safety Requirements*, MAC–2012, Revision, prepared for the U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado.

———, 2002. *Sensitivity Analysis of Groundwater Flow and Transport Models for the Moab Project Site–Letter Report*, MAC–MOA 19.1.2, prepared for the U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado, May.

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Appendix A

Drilling Statement of Work
Moab, Utah

Moab Project

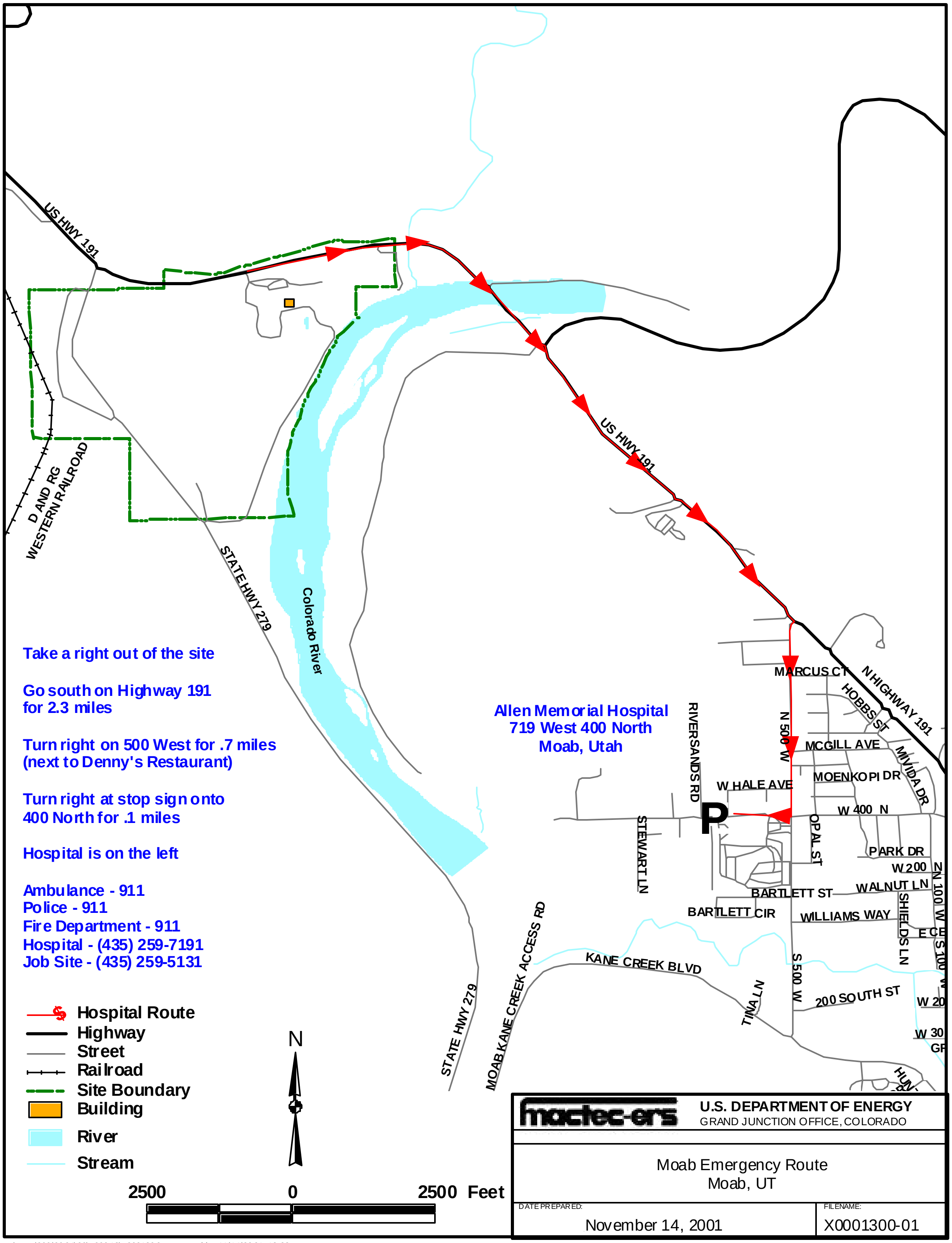
Drilling Statement of Work

Moab, Utah

May 2002

Prepared by
U.S. Department of Energy
Grand Junction Office
Grand Junction, Colorado

Work Performed Under DOE Contract Number DE–AC13–96GJ87335
Task Order Number MAC02–16



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Location and Hospital Route Map

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1.0 Introduction

1.1 Site Location and Background

The Moab Project Site (Moab site) is located at a former uranium-ore processing facility approximately 3 miles northwest of the city of Moab in Grand County, Utah (Figure 1–1). The plant was constructed in 1956 by the Uranium Reduction Company, which operated the mill until 1962 when the assets were sold to the Atlas Minerals Corporation (Atlas). Operations continued under Atlas until 1984. When the processing operations ceased in 1984, the mill had accumulated an estimated 10.5 million tons of uranium mill tailings in an unlined impoundment in the floodplain of the Colorado River. The tailings pile covers approximately 130 acres, is about 0.5 mile in diameter, averages about 94 feet in height above the surface of the Colorado River terrace, and is located about 750 feet west of the Colorado River. Atlas placed an interim cover over the tailings pile as part of decommissioning activities on going between 1988 and 1995. In October 2001, the title of the property and responsibility for remediation of the tailing pile and contaminated groundwater beneath the site were transferred to the U.S. Department of Energy (DOE).

DOE is currently in the process of preparing a plan to remediate the surface and groundwater contamination at the Moab site. The subsurface hydrogeology and geochemistry are complex in the vicinity of the Moab site and tailings area, which leads to uncertainties in defining the conceptual site model. Additional characterization data is needed to better define the water balance, assess the potential for a continuing source of contamination in the subpile sediments, and to perform a risk assessment for the site. This drilling statement of work outlines selected data collection activities and procedures for additional groundwater and tailings pile characterization required to support the plan for remediation.

1.2 Site Conditions

The Moab uranium millsite site is located three miles northwest of Moab adjacent to an outside meander of the Colorado River at the northwest end of Moab Valley (Figure 1-1). The ephemeral Moab Wash crosses the property just northeast of the tailings pile. The Moab site overlies Quaternary deposits derived mainly from the Colorado River, Moab and Courthouse Washes, and from cliffs located west of the site. The deposits include alluvium, talus, and eolian sediments. The “shallow alluvium” consists of sandy sediments (lenticular deposits of fine-grained, well-graded sands and silts with some gravels and clays, ranging in thickness from 8 to 30 feet. The “deeper alluvium” consists of gravelly sediments (interbedded sandy gravel and gravelly sands with occasional clay and silt rich intervals) ranging in thickness from 28 to greater than 406 feet. Various bedrock units believed to be of the Triassic Glen Canyon Group and older units, at different depths, underlie the unconsolidated sediments.

Ground water occurs under unconfined conditions in the alluvium beneath the site with depth to the water table ranging from 15 to 50 ft below ground surface. Ground water generally flows to the southeast toward the Colorado River. The alluvial system is recharged by infiltration of precipitation, Moab Wash, and the Colorado River during periods of high flow. An additional source of fresh water may originate from upwelling from the bedrock formation. The extent and magnitude of the upwelling, if any, from the bedrock formation is not known. The alluvial system discharges to the Colorado River during low flow conditions. The alluvial aquifer is chemically stratified by fresh and brine ground water regimes, which is a result of two distinct sources of water with a large disparity in dissolved solids. The fresh water regime is of primary interest because it occupies the upper portion of the alluvial sediments and is the primary system in which the site-derived constituents are transported. The lower brine ground water originates from the dissolution of evaporitic deposits in the Pennsylvanian Paradox Formation that are believed to sub crop near the Colorado River. The northern and vertical extent of the brine zone is not known.

1.2.1 Water Quality

Ground water in the shallow alluvium has been contaminated by uranium milling operations over the years. Constituents of concern (COCs), based on analytical information from several reports, consist of molybdenum, nitrate, selenium, uranium, ammonium, manganese, sulfate, and vanadium (SMI 2001). Distribution of COCs in the vicinity of the Moab site is based on existing characterization data and is shown in several documents (SMI 2001, NRC 1999a/1999b, ORNL 1998). Maximum concentrations are summarized in Table 1–1.

The list of COCs is based on information from several reports, with emphasis on the SMI report that summarizes water quality data from several of the previous sources (SMI 2001, NRC 1999a and 1999b, and ORNL 1998). There is some uncertainty associated with the list because historical sampling has not been consistent with regards to location of sampling points, selection of analytes, and depths in aquifer. Also the previous focus of the monitoring has reflected the Title II bias of short-term compliance with licensing agreements and interim ground water corrective action, and has not represented a comprehensive site-wide investigation that is typically performed at Title I processing sites for determination of the ground water cleanup and compliance strategy. The list of COCs will be confirmed when the Title I baseline risk assessment process is completed for the site.

Table 1-1. Concentrations for Inorganic Constituents in Ground Water at the Moab Site

Constituent	UMTRA MCL	Beneath Tailings Pile	Beneath Millsite Area
Arsenic	0.05	--	--
Barium	1.0	--	--
Cadmium	0.01	--	0.003
Chromium	0.05	--	--
Lead	0.05	--	--
Mercury	0.002	--	0.001
Molybdenum	0.10	10.8	1.73
Nitrate (N)	10	181	152
Selenium	0.01	--	0.024
Silver	0.05	--	--
Radium+	5*	--	--
Uranium+	0.044**	3.97	23.3
Gross alpha	15*	--	--
Ammonium		297	511
Chloride		2150	7460
Manganese		8.06	5.27
Nickel		--	0.03
Sodium		3020	6850
Sulfate		4910	15300
TDS		--	13700
Vanadium		0.015	0.40

Notes: UMTRA MCL for uranium = 0.044 mg/L if in equilibrium
Constituent distribution based on **maximum** sampling result -- sources = SMI (Table 2-20) -- based on **maximum** result from any monitor well from any date from any depth
* = pCi/L

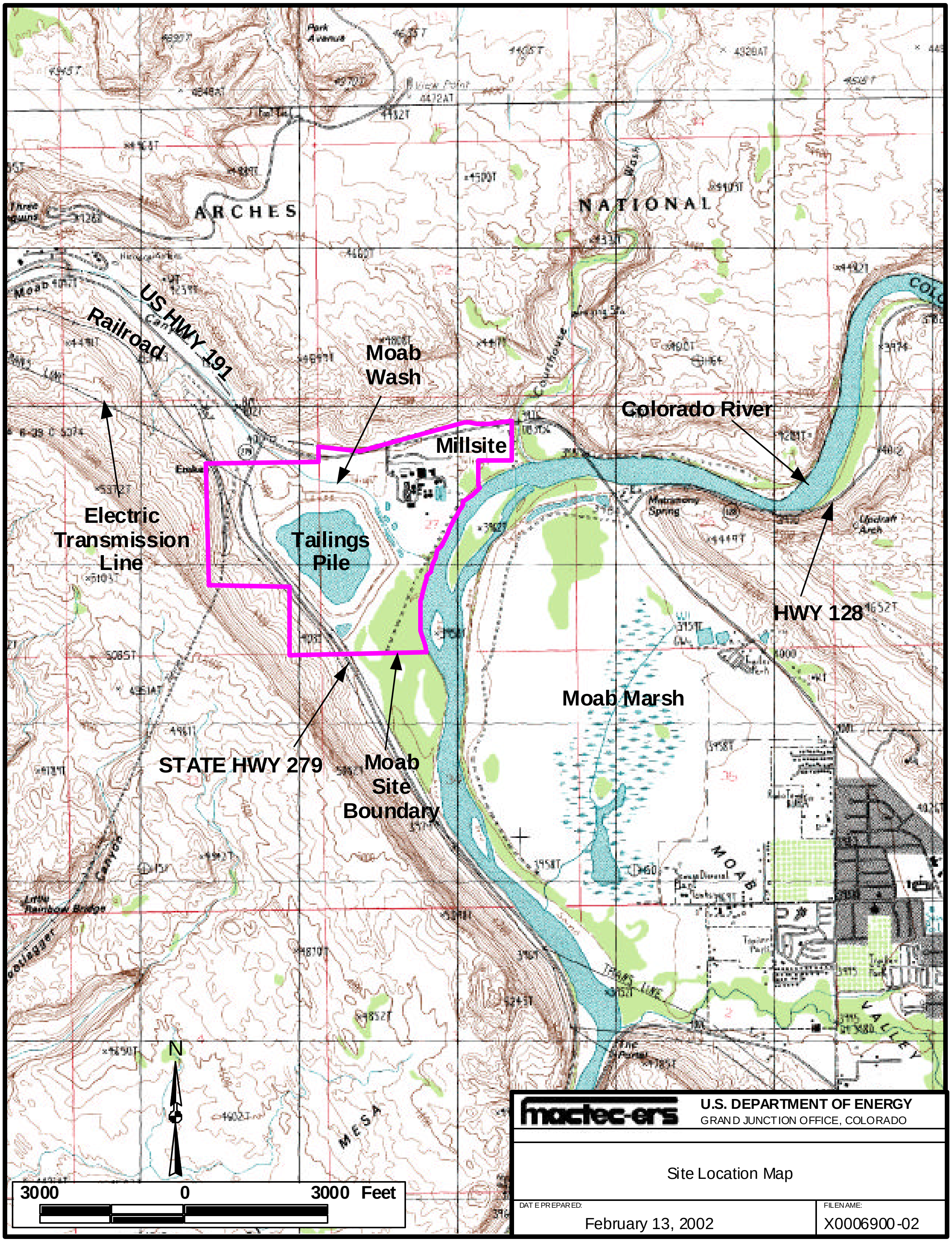

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Figure 1–1. Location of the Moab Project Site

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2.0 Scope

Outlined in this section are subcontract tasks required to collect the following data types.

- Core samples to identify the geologic bedrock formation sub cropping beneath the site.
- Monitor wells completed in the alluvium and in the bedrock formation to evaluate vertical flow gradients near the center of the site and to better estimate lateral recharge to the alluvium near the northern boundaries of the site.
- Sediment samples collected at three locations beneath the tailings pile from a hardened base layer (silt?), the unsaturated zone, and from the upper saturated zone.

2.1 Drilling and Well Installation

Drilling and installation work for monitor wells are listed below (Figure 2–1 and Table 2–1).

- Tailings Pile Boreholes and Wells—The drilling subcontractor shall drill 3 boreholes through the tailings pile and collect undisturbed, representative, and discrete samples of the hardened base layer (silt?), the subpile sediments in the unsaturated and saturated zones, and then core approximately 20-ft into the bedrock formation. The tailings pile is approximately 50-ft. thick. The unsaturated zone is approximately 30-ft thick. The saturated zone is estimated at 60-ft thick. **The subcontractor shall propose a drilling method that ensures the subpile samples are free from cross-contamination from the saturated tailings solid and liquids above the sample interval.** Each borehole shall be completed as a 2-inch inside diameter (I.D.) schedule 40 polyvinyl chloride (PVC) monitor well installed in the upper saturated zone of the alluvium. **The borehole above the upper filter pack shall be completed to ensure that downward leakage of tailings pore fluids and materials are prevented. Open borehole beneath the well screens lower filter pack shall be completed/abandoned in accordance with the State of Utah regulations and to ensure that fluids are prevented from entering the underlying bedrock formation.** The drilling subcontractor shall develop all wells by surging and bailing.
- Site Alluvial Monitor Wells—The drilling subcontractor shall drill and install 2-inch inside diameter (I.D.) schedule 40 polyvinyl chloride (PVC) alluvial monitor wells at six locations beneath the site. The subcontractor shall collect samples of the drill cuttings at five-foot intervals during the drilling and deliver the samples to the MACTEC–ERS geologist for lithologic logging. Three wells shall be completed in the upper saturated zone and three completed in the lower saturated zone of the underlying alluvial system. The drilling subcontractor shall develop all wells by surging and bailing.
- Site Bedrock Monitor Wells—The drilling subcontractor shall drill through the alluvium and core approximately 20-ft into the underlying bedrock formation. The subcontractor shall collect samples of the drill cuttings from the unconsolidated alluvium at five-foot intervals during the drilling and deliver the samples to the MACTEC–ERS geologist for lithologic logging. The drilling subcontractor shall then install 2-inch I.D. schedule 40 PVC wells completed in the bedrock formation. The drilling subcontractor shall develop all wells by surging and bailing.

2.2 Coring and Sampling

Coring and sediment sampling tasks are listed below (Figure 2–1 and Table 2–1).

- Bedrock Coring—The drilling subcontractor shall collect continuous core samples from the bedrock formation at 10 boring locations. Three of the ten borings are located on top of the tailings pile and the borings shall be completed as alluvial monitor wells after the core samples are retrieved (see previous section). The remaining seven borings shall be completed as bedrock monitor wells after the core samples are retrieved and packer tests are completed at three selected boreholes. Approximately 20 ft of core shall be collected at each bedrock boring. The subcontractor shall deliver the core to the MACTEC–ERS geologist for logging and provide core boxes for storage.
- Tailings Base Layer—The drilling subcontractor shall collect undisturbed, representative, and discrete samples of the hardened layer (silt?) at the base of the tailings pile. The estimated depth to the hardened layer is 50-ft. beneath the surface of the pile. The layer thickness is approximately 6-inches. **The subcontractor shall propose a sampling method that ensures the samples are free from cross-contamination from tailings material above the sample interval.** The subcontractor shall deliver the samples to the MACTEC–ERS geologist for logging and provide core boxes for storage.
- Subpile Sediments—The drilling subcontractor shall collect undisturbed, representative, and discrete sediment samples from beneath the tailings pile at 2-ft intervals. Sampling shall continue 10-ft beneath the alluvial water elevation. **The drilling subcontractor shall use a sampling method to ensure that the samples are free from cross-contamination from material above the sample interval.** The subcontractor shall deliver the samples to the MACTEC–ERS geologist for logging and provide core boxes for storage.
- Drill Cuttings—The subcontractor shall collect samples of the drill cuttings at five-foot intervals during the drilling of the site alluvial and bedrock wells. The subcontractor shall deliver the samples to the MACTEC–ERS geologist for lithologic logging.

Table 2–1. Summary of Monitor Wells to be Installed and Estimated Depths.

ID Number	Location Number	Drilling footage	Coring footage	Well Completion zone	Depth to top of screen (ft)	Screen length (ft)
430	1	100	20	Upper bedrock	90	10
431	2	100	20	Upper bedrock	90	10
432	3	60	20	Upper bedrock	50	10
433	4	90	20	Upper bedrock	80	10
434	5	60	20	Upper bedrock	50	10
435	6	80	20	Upper bedrock	70	10
436	7	120	20	Upper bedrock	110	10
437	8	140	20	Upper alluvium under pile	90	10
438	9	140	20	Upper alluvium under pile	90	10
439	10	140	20	Upper alluvium under pile	90	10
440	11	60	0	Shallow alluvium	50	5
441	12	60	0	Shallow alluvium	50	5
442	13	60	0	Shallow alluvium	50	5
443	14	80	0	Deep alluvium	70	10
444	15	60	0	Deep alluvium	50	10
445	16	100	0	Deep alluvium	90	10
Total		1,450	200			145

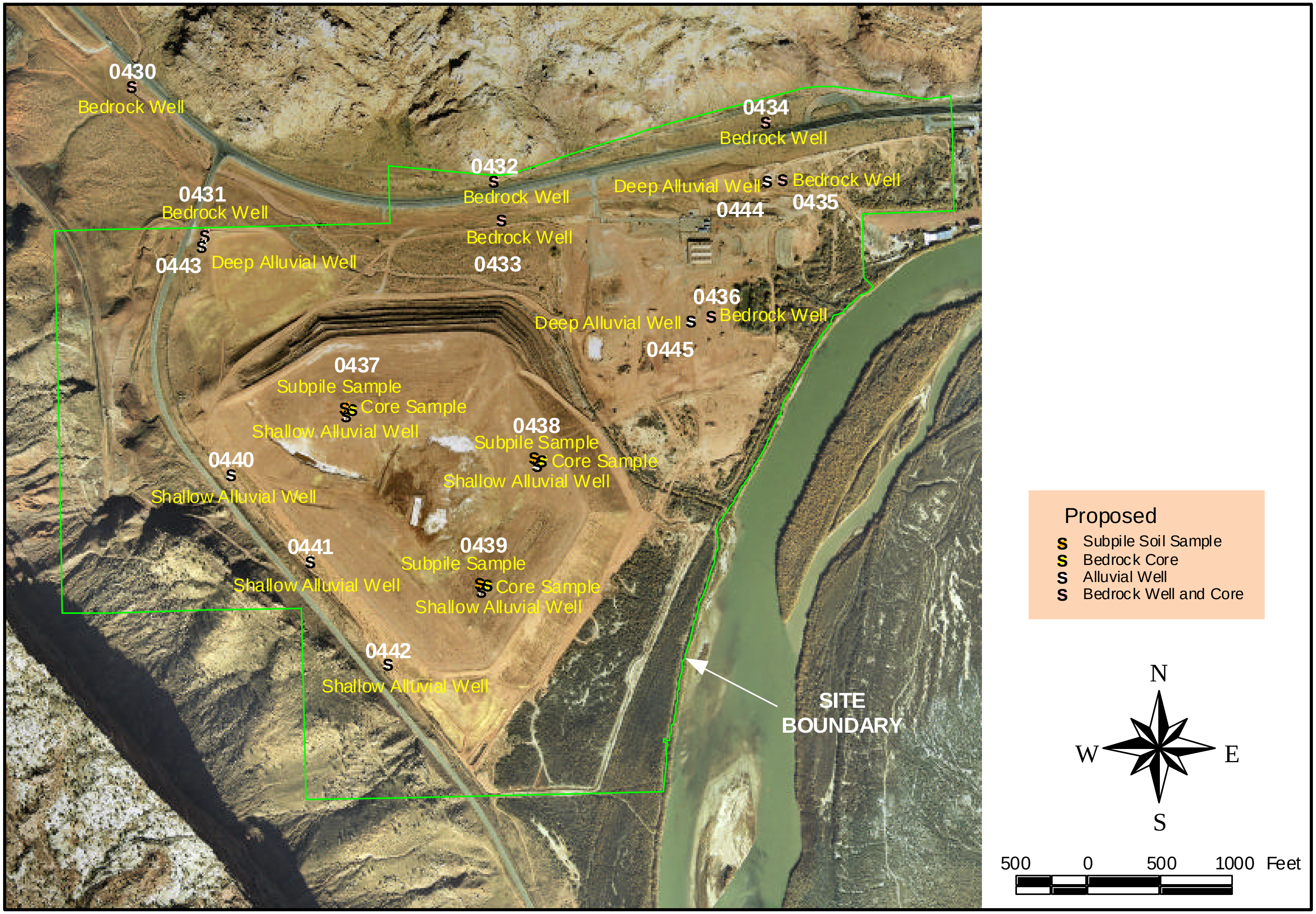

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Figure 2–1. Proposed Sample and Well Locations

3.0 Requirements and Specifications

Specifications and requirements for the drilling and sampling tasks are presented in this section. The MACTEC–ERS task leader (task leader) will establish all well locations, the number of boreholes and wells, samples, well completion materials, and dimensions and depths of wells. These factors are subject to change as additional information is obtained during the work.

The subcontractor shall drill boreholes and install wells that are sufficiently plumb and straight and will have no interference with the installation, alignment, operation, or future removal of pumps or other down-hole equipment. The subcontractor shall use only nonhydrocarbon-based lubricants, such as silicon or Teflon on any downhole equipment or tools. The subcontractor shall not use contaminating additives (e.g., diesel fuel, oil, barite), hydrocarbon-based lubricants (e.g., grease or oil), and biocides (e.g., formaldehyde) in the borehole or well. All well installation materials, e.g., sacks of bentonite, screens, casings, shall be delivered to each well site in factory sealed containers and remain in such until used in the well installation.

3.1 Drilling, Coring and Sampling Methods

The subcontractor shall propose a cost effective and expedient method and the equipment for drilling and installing the monitor wells, drilling the boreholes, coring, and for obtaining undisturbed, representative, and discrete sediment samples. **The drilling subcontractor shall use a drilling method to ensure that the samples are free from cross-contamination from material above the sample interval. The drilling subcontractor shall use a drilling method to ensure that downward leakage of tailings pore fluids and materials are prevented during and after the drilling operation**. The proposed drilling method and equipment shall be capable and rated to penetrate and advance through clay, loose sand, and gravel with cobbles to the desired depth. Lithologic samples shall be collected at selected intervals during the drilling, as directed by the task leader.

Casing advance systems such as ODEX and rotary vibratory (sonic type) drilling methods are acceptable. However, the relatively high quality of samples collected using sonic drilling makes the sonic drilling method more desirable than other casing advance methods. Mud rotary and hollow stem auger methods will not be considered. Air as the drilling fluid will not be accepted due to the health and safety concern of potentially suspending fine-grained radioactive tailing particles in the breathing zone. If the proposed drilling method proves insufficient for borehole stability and cuttings return, the task leader may authorize the use of approved water as the drilling fluid and non-bentonite drilling additives. If the use of water as a drilling fluid is approved, the subcontractor shall minimize the amount of water used during drilling through the tailings pile to prevent downward leakage of contaminants.

3.2 Sediment Sampling

The subcontractor shall collect samples from the subpile sediments at locations summarized in Table 2–1. **The drilling subcontractor shall use a drilling and sampling method to ensure that the samples are free from cross-contamination from material above the sample interval.** The MACTEC–ERS geologist will describe, mark and store the samples for laboratory analysis. The subcontractor will use a high-pressure steam cleaner (or equivalent method) to decontaminate the sampling equipment and other drilling tools that come in direct contact with the subpile samples before each sample run. Clean, potable water from an approved source will be used for cleaning.

The subcontractor shall also collect drill cuttings of the sediments from the monitor well locations at selected depth intervals as determined by the task leader for lithologic logging purposes.

3.3 Coring

An estimated 200 ft of core shall be collected from the bedrock formation at locations summarized in Table 2-1. Core shall be collected using nominal 5 or 10 ft long, double tube, swivel-type, NWG or NWM wireline core barrel or equivalent system and appropriate bits (see ASTM Standard D 2113-83 [Reproved 1987]). Water shall be used as the circulation medium. A minimum of two core barrels is required. The subcontractor shall use the best state-of-the-industry coring practices to affect the highest core recovery possible.

Core boxes shall be provided by the subcontractor, and shall be constructed of wood or other durable material. The boxes shall have lids and longitudinal separators. Recovered cores shall be laid out as a book would read, from left to right within the longitudinal separators. The beginning point for each box is the upper left hand corner (i.e. core from the shallowest portion of the hole will be placed starting in the upper left hand corner of the box; core representing the deepest portion of the hole will be in the furthest, lower right hand corner). Spacer blocks or plugs (provided by the subcontractor) shall be inserted into the core column within the longitudinal separators where no recovery was noted. All core boxes (including the lids) shall be permanently marked showing top and bottom and the beginning and ending depths for the core. Clean gloves shall be worn by all personnel handling the core.

3.4 Packer Testing

Once coring operations are completed, the subcontractor shall perform formation pressure (packer) testing at three selected locations on the site. These tests shall be run at the direction of the task leader. The tests will be conducted at 5-foot intervals or as directed by the task leader. The pump(s) used for the tests shall be fitted with a pulsation damper to minimize surging and pressure fluctuations. The minimum allowable packer inflation pressure will be 50 PSI over the maximum fluid pressure (higher packer inflation air pressures may be required to seat packers) and fluid pressures may range up to 50 PSI. The subcontractor shall provide all equipment and supplies required to conduct these tests. The subcontractor shall use a standard operating procedure consistent with the procedure published by the University of Missouri - Rolla (Pump-In Permeability Testing. Orlando, University of Missouri - Rolla Seminar for Drillers and Exploration Managers, 1981). A copy of the reference can be provided upon request.

Once the packer testing operations are completed, the subcontractor shall complete the borehole as a 2-inch monitor well.

3.5 Well Installation and Completion

The subcontractor shall begin the installation of the well materials when the desired total depth of the borehole is reached, as determined by the task leader. The subcontractor shall measure the depth of materials to the nearest tenth of a foot and report the measurements to the task leader.

The borehole diameter shall allow a minimum of 2-inch annular space between the borehole and the well casing. The monitor wells shall be constructed using the following materials:

- Johnson well screen (or equivalent), nominal 2-inch diameter, PVC schedule 40, 0.020-inch screen slot, 10-20 Colorado silica sand (or equivalent) for the primary filter pack, 20-40 Colorado silica sand (or equivalent) for the secondary filter pack, PVC schedule 40 blank casing, a 30 percent bentonite grout seal, a lockable j-plug.

The monitor wells shall be constructed in accordance with the following guidelines:

- The subcontractor shall begin installation of the well screen and casing when the desired total depth of the borehole is reached, as determined by the task leader.
- The subcontractor shall continue well installation with the placement of the primary filter pack to 2-ft above the top of the screen or as determined by the task leader. Pre-completion well development shall be performed, if necessary as determined by the task leader, to ensure a uniform and complete filling of the annular space with the filter pack that is free of voids or bridges.
- The subcontractor shall continue well installation with the placement of a minimum 3-ft secondary filter pack.
- When the top of the secondary filter pack is at the correct height, as determined by the task leader, the subcontractor shall then begin placement of a 5-ft bentonite seal (3/8-inch bentonite pellets). The subcontractor shall then hydrate the bentonite pellets by adding 5 gallons of water, if necessary, and allowing at least a 15 minute period for hydration and expansion of the pellets.
- The subcontractor shall install the 30 percent solids bentonite grout seal in the annular space from the top of the bentonite seal to within 3-ft of the ground surface. The subcontractor shall place the grout by pumping it through a tremie pipe in one continuous action completely filling the annular space. The subcontractor shall prepare the grout in accordance with the manufacturer's instructions and supervision of the task leader.

3.6 Well Development

The subcontractor shall develop all wells by a combination of surging or bailing. The subcontractor shall continue well development until the well is free of sediment, as determined by the task leader.

3.7 Well Head Protection

The subcontractor shall provide the following well head protection for the monitor wells:

- A steel casing extending 30 inches above the surface fitted with a locking, weather-proof lid (approximately 2-in of clearance) shall be placed over the riser casing of the well and cemented 3-ft in place, with a 1/8 in drain hole drilled near the base. MACTEC–ERS will supply the locks for the lids.
- The top 2-ft of the borehole shall be excavated and tapered away from the casing to allow the concrete to be placed below the frost line.

- A 3-ft wide, 3-ft long, and 6-in thick concrete pad (centered around the casing) having a slight slope away from the well casing shall be installed around the new monitor well.
- The annular area between the cover and the riser casing shall be filled with 1/4 in pea gravel up to 6-in below the top of the riser. The finished height of the PVC casing shall be cut square and approximately 2.0 ft above ground level. The top of the casing shall be equipped with a schedule 40 PVC cap.

3.8 Source of Water

The subcontractor shall obtain clean potable water from an approved source for drilling and other tasks associated with the work scope. The subcontractor shall have the necessary equipment to obtain, transport, and store water for use at the drill sites.

Tanks, hoses, pumps, and any other equipment used to transport or store the water shall be clean and free from all contamination. Further, the subcontractor shall protect the water from contamination during storage.

3.9 Equipment Cleaning

The subcontractor shall remove debris and any contamination from equipment with a high-pressure steam washer at the beginning of the drilling project and before leaving the project site. Water from the approved water source shall be used for all cleaning operations. The task leader will direct equipment cleaning and verify it clean when it is visibly free of all soil, oil, grease, and previous fluids.

3.10 Drill Cuttings and Fluid Disposal

The subcontractor shall spread drill cuttings and fluids evenly on the ground surface around the borehole after each borehole or well is completed.

3.11 Trash Disposal

The subcontractor shall collect and dispose of job-generated trash in a site approved receptical at least one time per day, at the end of each day, and maintain site housekeeping at all times.

3.12 Equipment Maintenance

The subcontractor may perform equipment maintenance, fueling, and repairs on location with the prior approval of the task leader. If, during this maintenance operation(s), the subcontractor spills any hydrocarbon-based fluid, antifreeze, or any other similar material, it shall immediately cleanup and remove the spilled material at its own time and expense. If, at any time, fluid leakage from any piece of the subcontractor's equipment, the subcontractor shall "diaper" the ground surface with plastic sheeting until the leak is fixed.

4.0 Contingencies and Site Procedures

4.1 Site Access

The drilling and sampling sites are accessible by existing roads or open ground. The subcontractor shall keep off-road driving to a minimum.

4.2 Site Conditions

The subcontractor shall be knowledgeable of general and local conditions that may affect the cost or quality of the performance of the work, including the ability of the subcontractor's equipment to perform the work. Refer to Article 40 of the Terms and Conditions for Subcontracts and Purchase Orders over $25,000 (GJO-PROC-114, August 1997)

4.3 Loss of Drilling Equipment and Hole Abandonment

Refer to Article 38 of the Terms and Conditions for Subcontracts and Purchase Orders over $25,000 (GJO-PROC-114, August 1997).

4.4 Daily Drilling Report

The subcontractor shall furnish to the task leader a completed and signed daily (or shift) drilling log that details all activities, rig functions, depths, pipe tallies, casing and other materials used, as well as any other pertinent project drilling, or safety data (including "tailgate" safety meetings and "rig inspections"). This information shall be recorded on the Drilling Report furnished by MACTEC–ERS (Figure 4–1). The Drilling Report form shall also be examined and signed each day or shift by the task leader. Any errors found on this report by the task leader will be reported to the subcontractor as soon as possible for reconciliation.

4.5 Utilities Clearance

MACTEC–ERS will stake each proposed location 7-days prior to the start of work. The subcontractor shall then notify the utility companies through the Blue Stakes one-call (800-662-4111) utility locate service no earlier than 7-days and no later than 48-hrs prior to start of work (notice does not include weekends or holidays). The subcontractor shall provide the utility locate service with the following street address for the project site:

Former Atlas Millsite
1871 North Highway 191
Moab, UT 84532

MACTEC–ERS site safety personnel will coordinate and escort the utility locators to each site. MACTEC–ERS will verify all utilities located, such as power lines or pipelines, that might reasonably be expected to exist within the work area, prior to commencement of work in accordance with 29 CFR 1926.651(b). The subcontractor shall repair any damage to known utilities during the performance of the work. The liability of other repairs shall be in accordance with Article 73 of the Terms and Conditions (GJO–PROC–114).

Grand Junction Office
2597 B ¾ Road
Grand Junction, CO 81503
(970) 248-6000

Drilling Report

State ________ County __________ Project _________________________ Hole Name _________________________ Hole No. __________

Drilling Contractor ______________________________________ Rig Type ______________________________________ Rig No. ____________

From A.M. P.M	To A.M. P.M.	Footage			Drilling (check)					Description of Work
		From	To	Hole Size	Drl	Cor	Rem	Agr	Sam	

Materials Used (e.g., casing, cement, water, mud, etc.)	Remarks
	Drill Crew
	Driller ______________________
	Helper ______________________
	Helper ______________________
	Other ______________________

Contract Foreman ______________________ GJO Representative ______________________ Report No. ________________ Date________

GJPO 1706 White—Return to GJO with Invoices(s) Canary—GJO Field Copy Pink—Rig Copy

Rev. 10/96

Figure 4–1. Drilling Report Form

4.6 Quality Assurance

A MACTEC–ERS representative will be present during the field activities. The subcontractor shall perform all fieldwork in accordance with the requirements, specifications, and procedures set forth herein. Periodic surveillance visits by other contractor personnel may be performed to verify the subcontractor's compliance with the requirements, specifications, and procedures set forth herein.

Upon request, the offeror shall provide additional information about previous site investigation work.

4.7 Permits and Licenses

MACTEC–ERS will provide all necessary access permits, well permits, and any permits for cuttings/fluid disposal as required by Federal, State, or other controlling agencies. The subcontractor shall acquire any drilling and/or contractor license(s) and any other permits required by Federal, State, or other controlling agencies.

4.8 Material Storage Facility

The subcontractor shall provide and maintain covered storage for items that could be affected by inclement weather. MACTEC–ERS will provide a lockable fenced area for drilling supplies. All material stored in this facility shall remain the property of the subcontractor until such time that the material is used or consumed by the project requirements. The storage facility is subject to Occupational Safety and Health Administration (OSHA) requirements for such things as housekeeping and fire protection.

4.9 Inventory

Prior to commencing work, the subcontractor and the task leader shall conduct an inventory to ensure adequate materials and supplies to perform the work are on the site and usable.

4.10 Site Sanitation Facilities

Portable toilet facilities are available at the job site.

End of current text

5.0 Health and Safety

5.1 Safety Requirements and Briefings

The task leader, in collaboration with MACTEC–ERS Site Safety Supervisor, will be responsible for operational health and safety coverage during the drilling activities. All subcontractor personnel shall comply with the MACTEC–ERS operational health and safety regulations as outlined in the *Drilling Health and Safety Requirements*, MAC–2012, Revision 3, October 2000. The “Statement of Understanding” contained in the *Drilling Health and Safety Requirements* shall be signed by all subcontractor personnel prior to working on this project. All subcontractor personnel working on this project shall be required to attend a pre-work briefing as soon as practical after the subcontractor has mobilized its equipment to the project site.

The subcontractor shall hold a safety tailgate meeting prior to the start of each day’s work. All subcontractor personnel and MACTEC–ERS personnel working on that days shift shall attend. The topic of discussion and attendee signatures will be recorded on a form. A copy of each daily record will be submitted to the MACTEC–ERS task leader.

All work will be suspended by the task leader or the subcontractor when an unsafe practice or condition is observed. Work will not proceed until the unsafe practice or condition is corrected and the task leader, or designee, approves the resumption of work. The subcontractor will not be compensated for efforts required to correct any unsafe practice or condition created by its actions.

Drilling rig trucks and/or carriers shall conform to all applicable Federal, State, and local safety requirements and regulations. Each truck or carrier shall be equipped with two U.S. Department of Transportation (DOT) approved, fully charged 2A:40BC dry chemical fire extinguishers, with current inspection tags.

5.2 Training Requirements

All subcontractor personnel are required to have a minimum of 40 hour Hazardous Waste Site training and Radiation Worker Level II (2 days). MACTEC–ERS can provide the Radiological Work II training at no cost to the subcontractor. Additionally, the subcontract crew will be working in personal protective equipment (PPE) consisting of booties and gloves over Tyvek® coveralls.

5.3 Equipment Inspections

The task leader will inspect the subcontractor’s drilling rig and all other subcontractor furnished equipment at the start of the project and at other times, as necessary, and record the conditions on an appropriate form. The subcontractor shall inspect its drilling equipment on a daily basis and record this on the Drilling Report each day. The subcontractor shall maintain and operate all of its equipment in accordance with all applicable regulations.

End of current text

6.0 Subcontractor Qualifications, Performance, and Requirements

6.1 Subcontractor Qualification

Due to the technical nature of the work, the subcontractor shall be a first-tier subcontractor to MACTEC–ERS, shall have a minimum of 5 years business experience in environmental and hazardous waste site water well drilling, and shall have the ability to provide the necessary and required drilling equipment. The subcontractor's driller shall have a minimum of 4 years in casing advance drilling experience and environmental and hazardous waste site well installations.

The successful subcontractor shall be mobilized to the site and ready to commence drilling immediately upon completion of the Green River drilling project. The subcontractor shall submit a work schedule with its proposal.

In the event of an award, the equipment proposed herein shall be the equipment used to perform the work.

6.2 Work Day and Rotation Schedule

The normal workday will consist of a minimum of 8 hours per day or through completion of a given well or boring. The workday shall be limited to the period of time starting no earlier than one-half hour before sunrise and ending no later than one-half hour after sunset. In all cases, MACTEC–ERS reserves the right to limit the length of the workday based on safety concerns. The subcontractor is responsible for obeying all Federal and State labor laws, rules, and regulations. Holidays excepted, the normal work schedule will consist of a "10 days on, 4 days off" rotation and will begin on a Tuesday and end on Thursday of the following week, or as mutually agreed.

6.3 Weather Day

The subcontractor shall not be compensated for any delays caused by weather. A "weather day" applies to any normal workday when weather conditions deteriorate to the point that fieldwork is neither safe, nor practical. The task leader, in consultation with the subcontractor, will decide whether or not to continue work.

6.4 Standby Time

Standby time is lost work time caused by MACTEC–ERS activities. The subcontractor shall be paid in accordance with the stipulated standby time rate. Standby time will only be paid when authorized by the task leader. Standby time will not be paid for subcontractor equipment breakdown, missing subcontractor equipment, insufficient supplies, or missing or tardy subcontractor personnel.

6.5 Submittals

The submittals are listed below in Table 6–1.

Table 6–1. Submittal Schedule

Submittal	Schedule
MSDS sheets for all materials to be brought on site and chemical inventory. Include type and brand of downhole tool lubricants to be used.	At date of mobilization or delivery to the site
Copies of reports, logs, and other State of Utah required documents	With final invoice
Specifications for casing, screen, and bentonite	With proposal
OSHA 200 log for 2000 and 2001	With proposal
Radiation Worker Level II training (2-days) certificate	With proposal
SARA 40-hr hazardous waste site training certificate	With proposal

Appendix B

Statement of Work
Direct-Push Piezometer Installations and
Soil Conductivity Measurements
Moab, Utah

EXHIBIT A

Moab Project

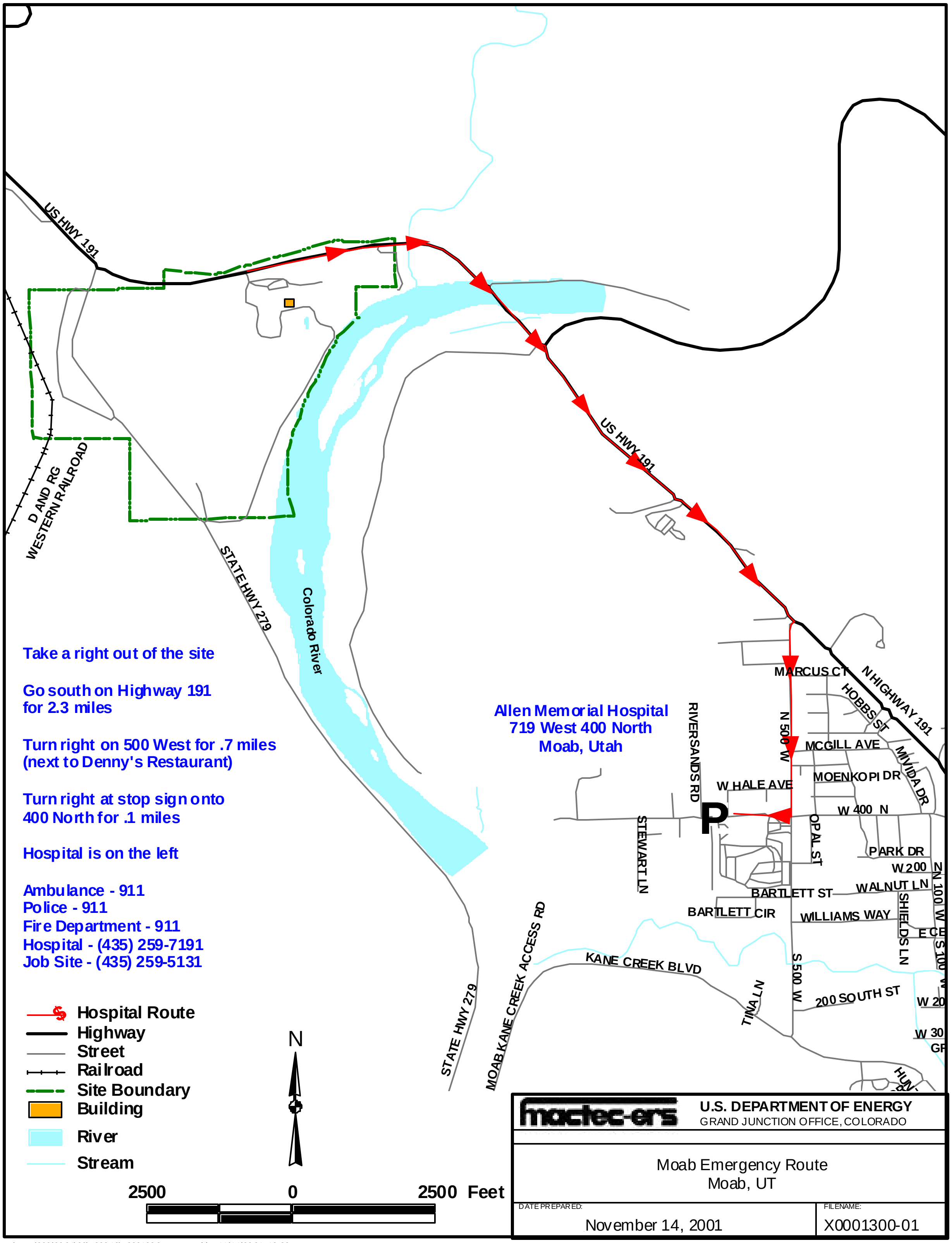
Statement of Work
Direct-Push Piezometer Installations and Soil Conductivity Measurements

Moab, Utah

May 2002

Prepared by
U.S. Department of Energy
Grand Junction Office
Grand Junction, Colorado

Work Performed Under DOE Contract Number DE–AC13–96GJ87335
Task Order Number MAC02–16



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Location and Hospital Route Map

Contents

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1.0 Introduction

1.1 Site Location and Background

The Moab Project Site (Moab site) is located at a former uranium-ore processing facility approximately 3 miles northwest of the city of Moab in Grand County, Utah (Figure 1–1). The plant was constructed in 1956 by the Uranium Reduction Company, which operated the mill until 1962 when the assets were sold to the Atlas Minerals Corporation (Atlas). Operations continued under Atlas until 1984. When the processing operations ceased in 1984, the mill had accumulated an estimated 10.5 million tons of uranium mill tailings in an unlined impoundment in the floodplain of the Colorado River. The tailings pile covers approximately 130 acres, is about 0.5 mile in diameter, averages about 94 feet in height above the surface of the Colorado River terrace, and is located about 750 feet west of the Colorado River. Atlas placed an interim cover over the tailings pile as part of decommissioning activities on going between 1988 and 1995. In October 2001, the title of the property and responsibility for remediation of the tailing pile and contaminated groundwater beneath the site were transferred to the U.S. Department of Energy (DOE).

DOE is currently in the process of preparing a plan to remediate the surface and ground water contamination at the Moab site. The subsurface hydrogeology and geochemistry are complex in the vicinity of the Moab site and tailings area, which leads to uncertainties in defining the conceptual site model. Additional characterization data is needed to better define the water balance, assess the potential for a continuing source of contamination in the subpile sediments, and to perform a risk assessment for the site. This drilling statement of work (SOW) outlines selected data collection activities and procedures for additional groundwater and tailings pile characterization required to support the plan for remediation.

1.2 Site Conditions

The Moab site is located three miles northwest of Moab adjacent to an outside meander of the Colorado River at the northwest end of Moab Valley (Figure 1–1). The ephemeral Moab Wash crosses the property just northeast of the tailings pile. The Moab site overlies Quaternary deposits derived mainly from the Colorado River, Moab and Courthouse Washes, and from cliffs located west of the site. The deposits include alluvium, talus, and eolian sediments. The "shallow alluvium" consists of sandy sediments (lenticular deposits of fine-grained, well-graded sands and silts with some gravels and clays, ranging in thickness from 8 to 30 feet. The "deeper alluvium" consists of gravelly sediments (interbedded sandy gravel and gravelly sands with occasional clay and silt rich intervals) ranging in thickness from 28 to greater than 406 feet. Various bedrock units believed to be of the Triassic Glen Canyon Group and older units, at different depths, underlie the unconsolidated sediments.

Ground water occurs under unconfined conditions in the alluvium beneath the site with depth to the water table ranging from 15 to 50 ft below ground surface. Ground water generally flows to the southeast toward the Colorado River. The alluvial system is recharged by infiltration of precipitation, Moab Wash, and the Colorado River during periods of high flow. An additional source of fresh water may originate from upwelling from the bedrock formation.

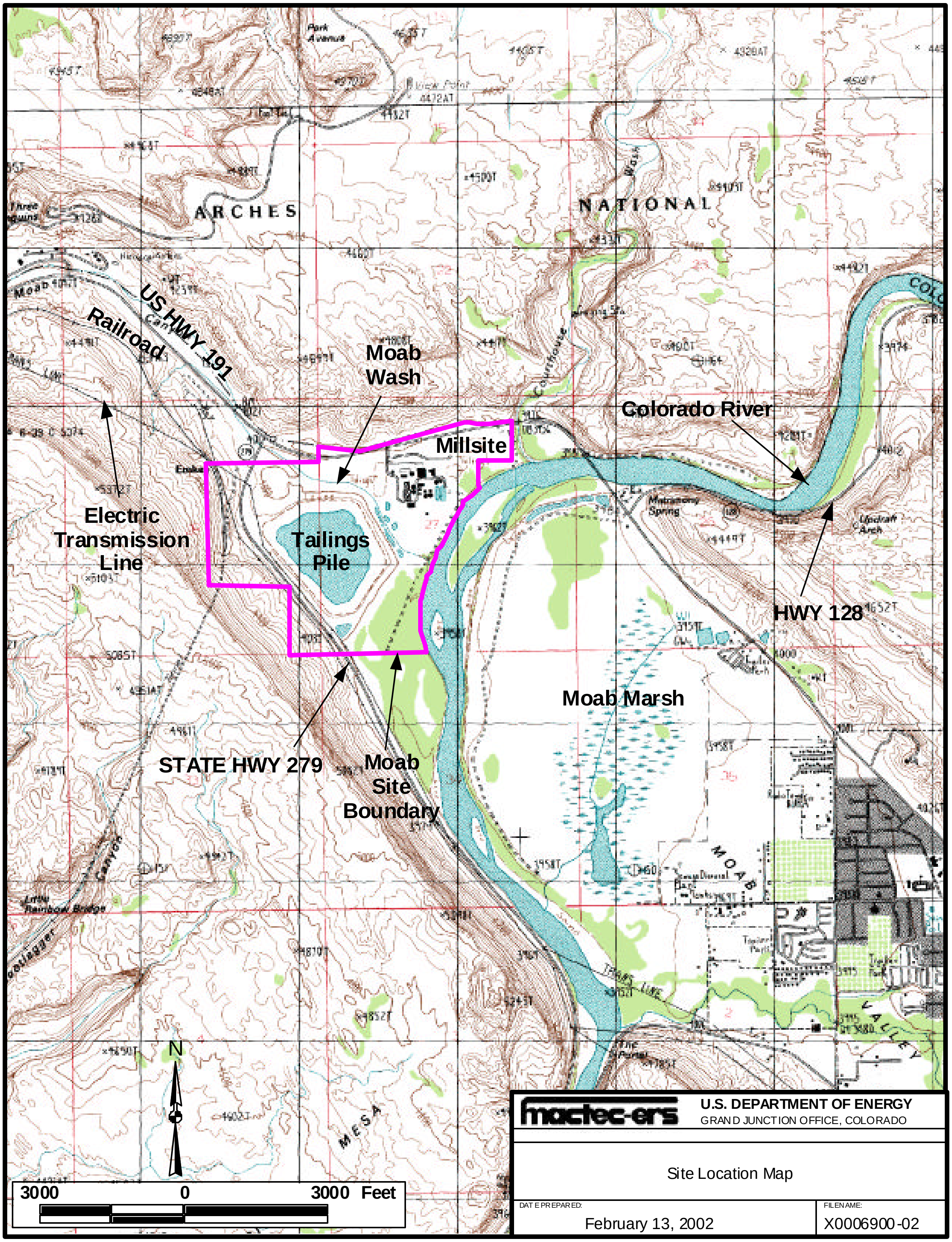

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Figure 1–1. Location of the Moab Project Site

The extent and magnitude of the upwelling, if any, from the bedrock formation is not known. The alluvial system discharges to the Colorado River during low flow conditions. The alluvial aquifer is chemically stratified by fresh and brine ground water regimes, which is a result of two distinct sources of water with a large disparity in dissolved solids. The fresh water regime is of primary interest because it occupies the upper portion of the alluvial sediments and is the primary system in which the site-derived constituents are transported. The lower brine ground water originates from the dissolution of evaporitic deposits in the Pennsylvanian Paradox Formation that are believed to sub crop near the Colorado River. The northern and vertical extent of the brine zone is not known.

Radioactive tailings are piled in an area that cover approximately 130 acres, is about 0.5 mile in diameter, averages about 94 feet in height above the surface of the Colorado River terrace, and is located about 750 feet west of the Colorado River. The pile consists of an outer compacted embankment of coarse tailings and an inner impoundment of both coarse and fine tailings. A thin interim cover of unconsolidated earth covers the tailings. Dewatering operations to remove excess liquid from the tailings is on going.

End of current text

2.0 Scope

The subcontractor shall propose a cost effective and expedient method and the equipment for installing piezometers and for mapping the brine zone in the alluvial aquifer. The subcontractor shall perform the following tasks as part of this SOW.

- Install 6 vibrating-wire piezometers in the tailings pile.
- Install 9 vibrating-wire piezometers in the alluvial aquifer along the Colorado River.
- Perform soil conductivity measurements at 12 locations in the former millsite area to map the extent of the underlying brine zone in the lower alluvial aquifer.

Presented in this section are the specifications and requirements for each task listed above. The MACTEC–ERS task leader (task leader) will establish all locations, depths, and quantities of piezometer installations and soil conductivity measurements. MACTEC–ERS will provide the vibrating-wire piezometers, anticipated to be Geokon Model 4500DP, or equivalent for installations in the tailings and Geokon Model 4500S, or equivalent for installations in the alluvial aquifer. These factors are subject to change as additional information is obtained before or during the work.

2.1 Piezometer Installations in Tailings Pile

The possibility of flux coming from the interior of the tailings pile will be investigated by monitoring internal pressure distributions with vibrating-wire piezometers. The subcontractor shall install six piezometers at the locations (415–420) shown in Figure 2–1. Piezometers will be installed in pairs at 20-ft and 40-ft below the surface into the saturated tailings slimes (fine grained tailings).

The subcontractor shall use a direct-push method to install the piezometers to the specified depth at a rate that will not create dynamic pore pressures that exceed the manufactures recommendations (Geokon Model 4500DP or equivalent).

2.2 Piezometer Installations in the Alluvial Aquifer

Measuring the direction and magnitude of flow gradients in the alluvial aquifer at several locations down gradient from the toe of the tailings pile will provide insight in how contaminants are discharging into the river. Interactions between the alluvial aquifer, the Colorado River, and the underlying brine zone will be investigated by monitoring internal pressure distributions with vibrating-wire piezometers. The subcontractor shall install nine piezometers at the locations (421–429) shown in Figure 2–1. Piezometers will be installed in nests of three at 20, 60, and 100 ft below the surface into the alluvial aquifer (sand, gravel and cobbles).

The subcontractor shall use a drilling method to advance one borehole to approximately 100-ft. at each of the three nested locations. The subcontractor shall install 3 piezometers at their specified depths (i.e. 20, 60, and 100-ft) in each borehole. MACTEC-ERS will provide the piezometers (Geokon Model 4500S or equivalent). The subcontractor shall provide all other equipment and installation materials as per manufacturer specifications for the piezometers.

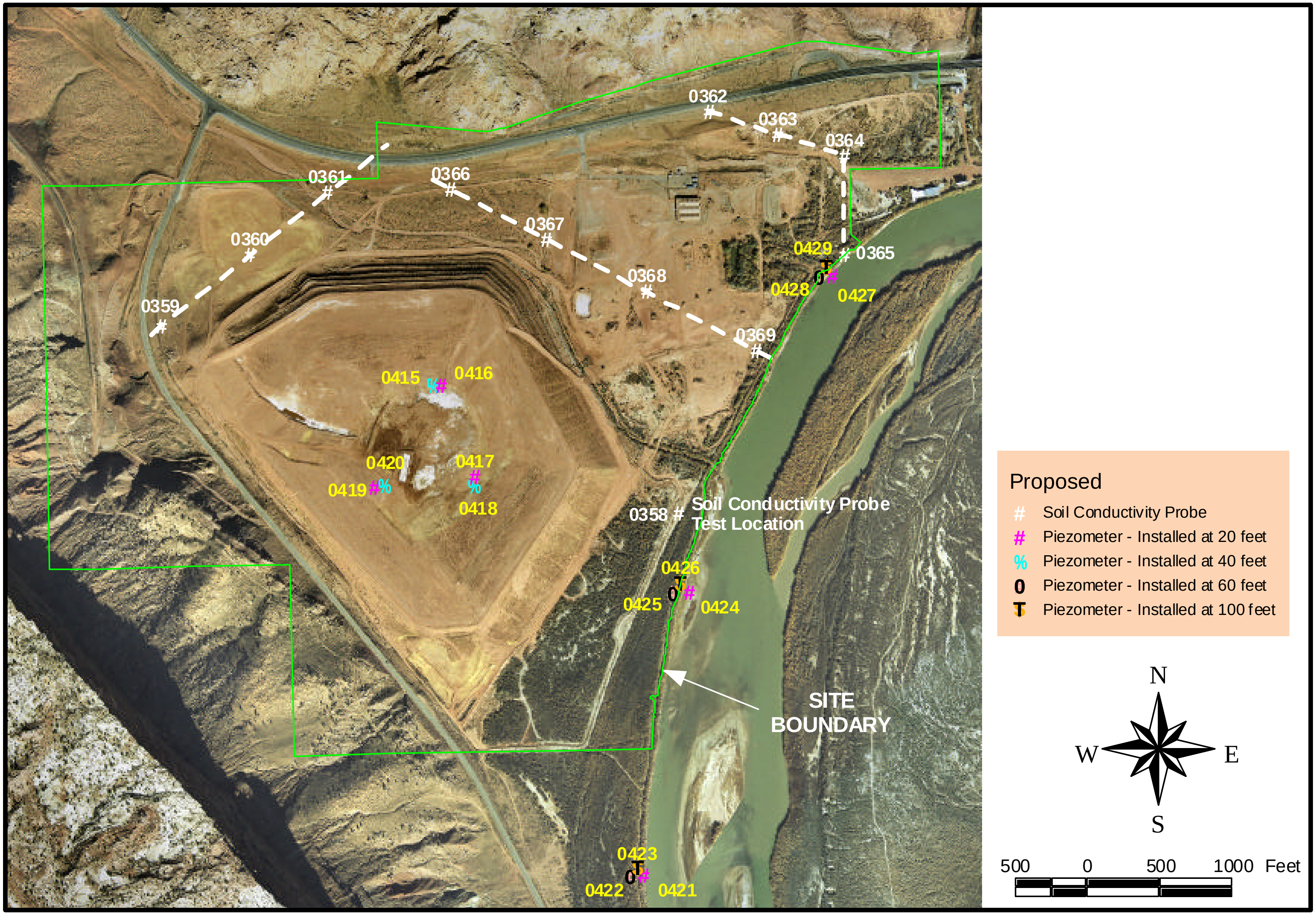

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Figure 2–1. Proposed Piezometer and Soil Conductivity Probe Locations

2.3 Soil Conductivity Logs

Specific conductance of the alluvial groundwater varies from 1,000 microSiemens per centimeter (µS/cm) to 100,000 µS/cm across the site. The depth of the contact between the fresh water system and the denser brine zone may be greater than 100-ft in places. The subcontractor shall propose a direct-push method in combination with a drilling method to measure electrical conductivity at 12 locations (358–369, Figure 2–1) to identify the nature and extent of the underlying brine groundwater system. The subcontractor shall calibrate the electrical conductivity instrument at the first location (358) where specific conductance measurements have been performed by MACTEC–ERS on water samples collected from discrete intervals from monitor well SMI–PW–02. Successful results of probing at this first test location will be used by the task leader to decide if additional probing at the other proposed locations is warranted.

The subcontractor shall use an electrical conductivity logging system that provides real-time display of conductivity versus depth and probing speed versus depth. A hard copy (chart) of the conductivity log and an electronic ASCII data file or equivalent shall be provided to the task leader for each location probed within 1-hr of the completion of a probing. Hard copy output shall consist of a computer-generated graph with the depth scale in units of feet and conductivity in microSiemens/meter. These plots will be plotted in an exact engineering scale, (i.e. at a scale easily read with a common engineering scale rule). In addition, points where the push is interrupted to add rods shall be noted on the graphs.

The subcontractor shall make every attempt to advance the electrical conductivity probe a minimum of 10 ft into the brine zone as determined by the task leader. Due to the nature of the substrata (i.e. sand, gravel, and cobbles) the subcontractor shall provide equipment that is capable of drilling through obstructions that cause refusal of the electrical conductivity probe advanced by direct-push. The proposed drilling method shall be used to advance the borehole at 5-ft intervals in the event of refusal of the direct-push electrical conductivity probe. The subcontractor shall backfill the borehole with drill cuttings after each probing is completed. Any excess drill cuttings shall be spread on the ground surface around the borehole after each probing is completed.

End of current text

3.0 Contingencies and Site Procedures

3.1 Site Access

The locations where piezometers are to be installed and where soil conductivity measurements will be performed are accessible by existing roads or open ground. The subcontractor shall keep off-road driving to a minimum.

3.2 Site Conditions

The subcontractor shall be knowledgeable of general and local conditions that may affect the cost or quality of the performance of the work, including the ability of the subcontractor's equipment to perform the work. Refer to Article 40 of the Terms and Conditions for Subcontracts and Purchase Orders over $25,000 (GJO-PROC-114, August 1997)

3.3 Loss of Drilling Equipment and Hole Abandonment

Refer to Article 38 of the Terms and Conditions for Subcontracts and Purchase Orders over $25,000 (GJO-PROC-114, August 1997).

3.4 Source of Water

If needed, the subcontractor shall obtain clean potable water from an approved source for drilling and other tasks associated with the work scope. The subcontractor shall have the necessary equipment to obtain, transport, and store water for use at the site.

Tanks, hoses, pumps, and any other equipment used to transport or store the water shall be clean and free from all contamination. Further, the subcontractor shall protect the water from contamination during storage.

3.5 Equipment Cleaning

The subcontractor shall remove debris and any contamination from equipment with a high-pressure steam washer at the beginning of the drilling project and before leaving the project site. Water from the approved water source shall be used for all cleaning operations. The task leader will direct equipment cleaning and verify it clean when it is visibly free of all soil, oil, grease, and previous fluids. Radiological surveys will be performed by MACTEC–ERS radiation control technicians prior to release of equipment from the site.

3.6 Drill Cuttings and Fluid Disposal

The subcontractor shall backfill the borehole with drill cuttings and spread excess drill cuttings on the ground surface around the borehole after each probing is completed.

3.7 Trash Disposal

The subcontractor shall collect and dispose of job-generated trash in a site approved receptacle at least one time per day, at the end of each day, and maintain site housekeeping at all times.

3.8 Equipment Maintenance

The subcontractor may perform equipment maintenance, fueling, and repairs on location with the prior approval of the task leader. If, during this maintenance operation(s), the subcontractor spills any hydrocarbon-based fluid, antifreeze, or any other similar material, it shall immediately cleanup and remove the spilled material at its own time and expense. If, at any time, fluid leakage from any piece of the subcontractor's equipment, the subcontractor shall "diaper" the ground surface with plastic sheeting until the leak is fixed.

3.9 Daily Drilling Report

The subcontractor shall furnish to the task leader a completed and signed daily (or shift) drilling log that details all activities, rig functions, depths, pipe tallies, casing and other materials used, as well as any other pertinent project, or safety data (including "tailgate" safety meetings and "rig inspections"). This information shall be recorded on the Drilling Report furnished by MACTEC–ERS (Figure 3–1). The Drilling Report form shall also be examined and signed each day or shift by the task leader. Any errors found on this report by the task leader will be reported to the subcontractor as soon as possible for reconciliation.

3.10 Utilities Clearance

MACTEC-ERS will stake each proposed location 7-days prior to the start of work. The subcontractor shall then notify the utility companies through the Blue Stakes one-call (800-662-4111) utility locate service no earlier than 7-days and no later than 48-hrs prior to start of work (notice does not include weekends or holidays). The subcontractor shall provide the utility locate service with the following street address for the project site:

Former Atlas Millsite
1871 North Highway 191
Moab, UT 84532

MACTEC-ERS site safety personnel will coordinate and escort the utility locators to each site. MACTEC–ERS will verify all utilities located, such as power lines or pipelines, that might reasonably be expected to exist within the work area, prior to commencement of work in accordance with 29 CFR 1926.651(b). The subcontractor shall repair any damage to known utilities during the performance of the work. The liability of other repairs shall be in accordance with Article 73 of the Terms and Conditions (GJO–PROC–114).

3.11 Quality Assurance

A MACTEC–ERS representative will be present during the field activities. The subcontractor shall perform all fieldwork in accordance with the requirements, specifications, and procedures set forth herein. Periodic surveillance visits by other contractor personnel may be performed to verify the subcontractor's compliance with the requirements, specifications, and procedures set forth herein.

Upon request, the offeror shall provide additional information about previous site investigation work.

Grand Junction Office
2597 B ¾ Road
Grand Junction, CO 81503
(970) 248-6000

Drilling Report

State ________ County __________ Project ________________________ Hole Name ________________________ Hole No. __________

Drilling Contractor ____________________________________ Rig Type ____________________________________ Rig No. _____________

From A.M. P.M	To A.M. P.M.	Footage			Drilling (check)					Description of Work
		From	To	Hole Size	Drl	Cor	Rem	Agr	Sam	

Materials Used (e.g., casing, cement, water, mud, etc.)	Remarks
	Drill Crew
	Driller ______________________
	Helper ______________________
	Helper ______________________
	Other ______________________

Contract Foreman ________________________ GJO Representative ________________________ Report No. ____________________ Date_________

GJPO 1706 White—Return to GJO with Invoices(s) Canary—GJO Field Copy Pink—Rig Copy

Rev. 10/96

Figure 3–1. Drilling Report Form

3.12 Permits and Licenses

MACTEC–ERS will provide all necessary access permits, well permits, and any permits for cuttings/fluid disposal as required by Federal, State, or other controlling agencies. The subcontractor shall acquire any drilling and/or contractor license(s) and any other permits required by Federal, State, or other controlling agencies.

3.13 Material Storage Facility

The subcontractor shall provide and maintain covered storage for items that could be affected by inclement weather. MACTEC–ERS will provide a lockable fenced area for drilling supplies. All material stored in this facility shall remain the property of the subcontractor until such time that the material is used or consumed by the project requirements. The storage facility is subject to Occupational Safety and Health Administration (OSHA) requirements for such things as housekeeping and fire protection.

3.14 Inventory

Prior to commencing work, the subcontractor and the task leader shall conduct an inventory to ensure adequate materials and supplies to perform the work are on the site and usable.

3.15 Site Sanitation Facilities

Portable toilet facilities are available at the job site.

End of current text

4.0 Health and Safety

4.1 Safety Requirements and Briefings

The task leader, in collaboration with MACTEC–ERS Site Safety Supervisor, will be responsible for operational health and safety coverage during the drilling activities. All subcontractor personnel shall comply with the MACTEC–ERS operational health and safety regulations as outlined in the *Drilling Health and Safety Requirements*, MACB2012, Revision 3, October 2000. The "Statement of Understanding" contained in the *Drilling Health and Safety Requirements* shall be signed by all subcontractor personnel prior to working on this project.

The subcontractor shall hold a safety tailgate meeting prior to the start of each day's work. All subcontractor personnel and MACTEC-ERS personnel working on that days shift shall attend. The topic of discussion and attendee signatures will be recorded on a form. A copy of each daily record will be submitted to the MACTEC–ERS task leader.

All work will be suspended by the task leader or the subcontractor when an unsafe practice or condition is observed. Work will not proceed until the unsafe practice or condition is corrected and the task leader, or designee, approves the resumption of work. The subcontractor will not be compensated for efforts or down time required to correct any unsafe practice or condition created by its actions.

Rigs, trucks and/or carriers shall conform to all applicable Federal, State, and local safety requirements and regulations. Each truck or carrier shall be equipped with two U.S. Department of Transportation (DOT) approved, fully charged 2A:40BC dry chemical fire extinguishers, with current inspection tags.

4.2 Training Requirements

All subcontractor personnel are required to have a minimum of 40 hour Hazardous Waste Site training and Radiation Worker Level II (2 days). If needed, the Radiation Worker Level II training will be provided to the subcontractor at no cost. Additionally, the subcontract crew will be working in PPE consisting of booties and gloves over Tyvek® coveralls provided by MACTEC–ERS at no cost to the subcontractor.

All subcontractor personnel working on this project shall be required to attend a pre-work briefing as soon as practical after the subcontractor has mobilized its equipment to the project site.

4.3 Equipment Inspections

The task leader will inspect the subcontractor's rig and all other subcontractor furnished equipment at the start of the project and at other times, as necessary, and record the conditions on an appropriate form. The subcontractor shall inspect its drilling equipment on a daily basis and record this on the Drilling Report each day. The subcontractor shall maintain and operate all of its equipment in accordance with all applicable regulations.

End of current text

5.0 Subcontractor Qualifications, Performance, and Requirements

5.1 Subcontractor Qualification

Due to the technical nature of the work, the subcontractor shall be a first-tier subcontractor to MACTEC–ERS, shall have a minimum of 3 years business experience in installation of piezometers and collection of soil conductivity measurements at environmental and hazardous waste sites, and shall have the ability to provide the necessary and required equipment. The subcontractor's operator shall have a minimum of 2 years experience in direct-push methods and collection and interpretation of soil conductivity data at environmental and hazardous waste sites.

The successful subcontractor shall be mobilized to the site and ready to commence work no later than June 18, 2002. An earlier start date may be acceptable. The subcontractor shall submit a work schedule with its proposal.

In the event of an award, the equipment proposed herein shall be the equipment used to perform the work.

5.2 Work Day and Rotation Schedule

The normal workday will consist of a minimum of 8 hours per day or through completion of a given piezometer installation or soil conductivity boring. The workday shall be limited to the period of time starting no earlier than one-half hour before sunrise and ending no later than one-half hour after sunset. In all cases, MACTEC–ERS reserves the right to limit the length of the workday based on safety concerns. The subcontractor is responsible for obeying all Federal and State labor laws, rules, and regulations. Holidays excepted, the normal work schedule will consist of a "10 days on, 4 days off" rotation and will begin on a Tuesday and end on Thursday of the following week, or as mutually agreed.

5.3 Weather Day

The subcontractor shall not be compensated for any delays caused by weather. A "weather day" applies to any normal workday when weather conditions deteriorate to the point that fieldwork is neither safe, nor practical. The task leader, in consultation with the subcontractor, will decide whether or not to continue work.

5.4 Standby Time

Standby time is lost work time caused by MACTEC–ERS activities. The subcontractor shall be paid in accordance with the stipulated standby time rate. Standby time will only be paid when authorized by the task leader. Standby time will not be paid for subcontractor equipment breakdown, missing subcontractor equipment, insufficient supplies, or missing or tardy subcontractor personnel.

5.5 Submittals

The submittals are listed below in Table 5–1.

Table 5–1. Submittal and Deliverable Schedule

Submittal	Schedule
MSDS sheets for all materials to be brought on site and chemical inventory. Include type and brand of downhole tool lubricants to be used.	At date of mobilization or delivery to the site
Copies of reports, logs, and other State of Utah required documents	Submit with final invoice
Specifications for soil conductivity probe and associated data collection equipment.	Submit with proposal
OSHA 200 log for 2000 and 2001	Submit with proposal
Radiation Worker Level II training (2-days) certificate	Submit with proposal
SARA 40-hr hazardous waste site training certificate	Submit with proposal
Final report documenting the work performed, copies of conductivity logs, ASCII data files, and a summary of the results and analysis.	20-days after completion of work

Appendix C

Standard Operating Procedures

(DOE [continually updated]. Grand Junction Office Environmental Procedures Catalog, GJO–6, U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado)

GENERAL SAMPLING PROCEDURES

Standard Practice for Field Documentation Processes [GT–1(P)]
Standard Practice for Sample Labeling [GT–2(P)]
Standard Practice for Chain–of–Sample–Custody Control and Physical Security of Samples [GT–3(P)]

GROUND WATER SAMPLING PROCEDURES

Standard Test Method for the Measurement of Water Levels in Ground Water Monitoring Wells [LQ–2(T)]
Standard Practice for Purging of Monitoring Wells [LQ–3(P)]
Standard Test Method for the Field Measurement of pH [LQ–4(T)]
Standard Test Method for the Field Measurement of Specific Conductance [LQ–5(T)]
Standard Test Method for the Field Measurement of the Oxidation–Reduction Potential (Eh) [LQ–6(T)]
Standard Test Method for the Field Measurement of Alkalinity [LQ–7(T)]
Standard Test Method for the Measurement of Temperature [LQ–8(T)]
Standard Test Method for the Measurement of Dissolved Oxygen [LQ–9(T)]
Standard Practice for the Use of a Flow Cell for Field Measurements [LQ–10(P)]
Standard Practice for the Sampling of Liquids [LQ–11(P)]
Standard Practice for the Collection, Filtration, and Preservation of Liquid Samples [LQ–12(P)]
Standard Practice for the Inspection and Maintenance of Groundwater Monitoring Wells [LQ–18(P)]
Standard Test Method for Turbidity in Water [LQ–24(T)]

SOIL SAMPLING PROCEDURES

Standard Practice for Sampling Surface Soil, Sediments and Sludge [SL–3(P)]
Standard Practice for Operation of the Power Auger, Corer, and Demolition Hammer [SL–4(P)]

AQUIFER TESTING PROCEDURES

Standard Practice for Analyzing Slug Test Data for Estimating the Hydraulic Conductivity of Saturated Porous Media [LQ–15(P)]
Standard Test Method for Performing a Water Injection Test [LQ–17(T)]
Standard Practice for the Inspection and Maintenance of Groundwater Monitoring Wells [LQ–18(P)]
Standard Test Method for Conducting Slug Tests in Aquifers [LQ–22(T)]
Technical Comments on ASTM D 5092—Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers [LQ–14(P)]